AMMONIA ON DEMAND (AOD ™)
NEW ALTERNATIVE FOR
AN AMMONIA SUPPLY SYSTEM
FOR SCR/SNCRs

Hamilton Walker
E-Mail: **hgwalker@eec1.com**
Tel: 410.368.7046
Fax: 410.368.6721
Environmental Elements Corporation
3700 Koppers Street
Baltimore, MD 21227

SUMMARY

To date, all SCR systems and ammonia based SNCR systems supplied in North America have utilized either anhydrous or aqueous ammonia as a feedstock for NO_X reducing agent. Unfortunately, anhydrous ammonia, as well as aqueous ammonia in strengths above 20%, present significant danger to human health and are classified by OSHA as hazardous chemicals. Their transportation, storage and handling triggers serious safety and environmental regulatory requirements for risk management plans, accident prevention programs, emergency response plans and release analysis. Aqueous ammonia solutions with low concentration present lower health and safety risks but their usage results in a substantial increase in operating costs of SCR and SNCR systems.

An alternative approach to ammonia supply suggested in late eighties includes using benign urea feedstock to generate ammonia on site. Urea is an environmentally safe material used primarily as fertilizer. It can be safely transported, stored and handled at the plant site without special precautions. In this case there is no need to transport and store a dangerous chemical and the amount of ammonia at the power plant at any moment is significantly smaller than the EPA reportable spill quantity. It has been determined that using urea hydrolysis is the preferred process for converting urea/water solution into a gaseous mixture containing ammonia, carbon dioxide and water vapor. The amounts of CO_2 and H_2O injected with ammonia are negligible when compared with

concentrations of these components already present in the flue gas.
HERA LLC, a California based consulting firm and Siirtec Nigi S.p.A., an Italian process equipment supply company have developed a patented process for commercial implementation of urea hydrolysis in the power plant environment. This technology is licensed exclusively to Environmental Elements Corporation. The AOD™ process and corresponding equipment are designed on the basis of over thirty years of experience with design and manufacturing of commercial hydrolyzers for urea plants and, what is most important, nineteen years of design and start-up of full scale deep hydrolysis units (over 70 installed).

Special steps have been taken during the system design to ensure high efficiency hydrolysis, long term reliable operation and to prevent injection of any products of incomplete hydrolysis into the flue gas flow upstream from the SCR catalyst. These measures include recycling of spent urea solution, accomplishing hydrolysis in multiple stages at specific temperature and pressure, and additional cleaning of gaseous products as well as of fresh urea solution. Special attention is also paid to a proper choice of materials of different system components (urea solution is very corrosive at high temperatures and appropriate grades of steel were verified in many full-scale installations worldwide).

Economic comparison of ammonia supply systems using three different feedstocks (anhydrous ammonia, aqueous ammonia and dry urea) shows that while the capital costs of the AOD™ system are typically slightly higher, the operating costs are significantly higher (over 50%) for 29% aqueous ammonia and especially for 19% aqueous ammonia (over 70%). The higher initial investment cost for the urea based systems will be paid back in less than one year due to the lower operating, maintenance and compliance costs. Using anhydrous ammonia is typically less expensive, but presents an obvious danger to the health and safety of power plant personnel and neighboring communities.

Based on the economic analysis of using urea feedstock and a thorough review of different designs, Southern Energy, Inc. (SEI) decided to purchase the AOD™ system from EEC for installation at the Unit 1 SCR at the Canal Station in Sandwich, Massachusetts. This station is located in the densely populated area (at the north end of the Cape Cod Canal) and SEI's decision not to use anhydrous or aqueous ammonia resulted in a smoother and expedited permitting process.

In addition to typical requirements for high system reliability, minimal installation and operating costs, additional design criteria included minimal environmental impacts and minimal visual impact of the system. The AOD™ process has no continuous discharge stream except for the ammonia and carbon dioxide gases injected into the boiler. The liquid phase is totally contained within the process. The weak urea solution from the reactor is returned to the mix tanks to be recycled. All vents are collected and ducted to the boiler flue gas duct ahead of the SCR, so the process has essentially no environmental impact. Minimal visual impact was achieved by integrating the storage silos with the self-contained process skid, which eliminated a separate site for the silos. All equipment is finished with exterior siding to match the existing plant exterior.

Many extra features and upgrades were incorporated into the standard EEC design on early stages of the project

based on SEI requests. The AOD™ system for Canal Station was designed and manufactured by EEC and delivered to the plant site. The specifics of the installation and start-up of this system are included in the presentation.

Commercialization of a new technology for urea based ammonia generation by Environmental Elements Corporation is a new step to provide ammonia-risk-free SCR systems to U.S. power plants.